PSEG COMMENTS
REGIONAL TRANSMISSION INITIATIVE
NOTICE OF REQUEST FOR INFORMATION and SCOPING MEETING

I. Introduction

PSEG Renewable Transmission LLC (PSEG) appreciates the opportunity to provide these comments in response to the New England States Transmission Initiative's Request for Information (RFI) announced on September 1, 2022, in support of the New England Energy Vision. PSEG's responses describe the recommended methods to plan, design and develop the transmission infrastructure necessary to permit offshore wind integration, and to provide access to the federal funds available through the United States Department of Energy (DOE) and the Infrastructure and Investment Jobs Act (IIJA). PSEG supports the New England States' initiatives to meet their clean energy goals and hopes these responses will contribute to the continuing efforts of the States. PSEG is also well-positioned to provide support and advance the goals of the Participating States. We are able to leverage our recent experience with the State Agreement Approach process in New Jersey as well as our strategically located properties in Connecticut.

II. Description of PSEG Renewable

PSEG Renewable Transmission LLC, an indirect, wholly-owned subsidiary of Public Service Enterprise Group Incorporated.

Public Service Enterprise Group (PSEG) is a predominantly regulated infrastructure company focused on a clean energy future. Guided by its Powering Progress vision, PSEG aims to power a future where people use less energy, and it's cleaner, safer and delivered more reliably than ever. PSEG's commitment to ESG and sustainability is demonstrated in our net-zero 2030 climate vision, our pursuit of science-based emissions reductions targets and participation in the U.N. Race to Zero, as well as our inclusion on the Dow Jones Sustainability North America Index, the Bloomberg Gender-Equality Index and the list of America's most JUST Companies. PSEG's businesses include Public Service Electric and Gas Co. (PSE&G), PSEG Power and PSEG Long Island.

PSEG is a company with a purpose. Its core commitments – safety, integrity, continuous improvement, customer service and diversity, equity and inclusion – will continue to guide our company.

PSEG strives to put the principles of ESG and sustainability – environment stewardship, social responsibility, and ethical governance – at the forefront of our mission. While ESG investing is a relatively recent tool for helping corporations focus on sustainable business operations, its principles have been at the forefront of our strategy for many years. Throughout this time, our business strategy has considered not only how the effects of climate change might impact PSEG operations and its investors, but also how our business operations impact the communities in which we, and how we can help all of our stakeholders manage its risk and uncertainties.

III. <u>PSEG's Responses</u>

A. Comments on Changes and Upgrades to the Regional Electric Transmission System Needed to Integrate Renewable Energy Resources

1. *Comment on how individual states, Participating States, or the region can best position themselves to access U.S. DOE funding or other DOE project participation options relating to transmission, including but not limited to funding, financing, technical support, and other opportunities available through the federal Infrastructure and Investment Jobs Act;*

   Response: The DOE provides low cost financing and grants to qualifying transmission projects. In order to identify which DOE subsidies to target, ISO New England, Inc. (ISO-NE or ISO) should seek to align their goals and proposed solutions with state Public Utility Commissions (PUC). This is key given that the Inflation Reduction Act (IRA) of 2022 did not include an investment tax credit for transmission projects.

   Front-end planning of the transmission infrastructure and regional collaboration can enhance reliability and enable power flows to be directed where it's needed the most. This will enhance reliability and resilience within the ISO, and broadly throughout the region. Despite not currently being eligible for an Investment Tax Credit (ITC), these benefits coupled with grants and loans available from the DOE can support an investment decision in a planned transmission solution.

   Although PSEG is unable to quantify the benefit of the DOE programs as these financing options are specific to each project, the relevant grant opportunities most likely to be available to support transmission system owners and operators include private and public Grid Resilience and Innovation Partnerships (GRIP) as well as IRA programs. These include but are not limited to:

   - Grid Resilience Grants, IIJA 40101(c) has $2.5B of funding available. Depending on the design, it is likely that some aspects of planned transmission solution integrating offshore wind will be able to qualify for funds under this program.
   - Smart Grid Investment Matching Grant Program, 42 U.S.C. 6321, funded by IIJA: Sec. 40107 has an available funding of $3B which can cover the cost of fiber optic communication and switching equipment, HVDC system and HVAC interlink equipment enabling smart grid functions.
   - Innovative Grid Resilience program, IIJA Sec. 40103(b) has an available funding of $5B which covers up to 50% of most major project equipment. Close integration with state goals are recommended to build an appropriate application and seek funds to recover costs of the project consistent with the acceleration of the interconnection of clean energy generation
   - Grid Resilience Grants, IIJA 40101(d) has an available funding of $2.5B for states to support grid resilience opportunities.
   - IRA Facilitating the Interconnection of Interstate Electricity Transmission Lines, Sec. 50152 has an available funding of $760M for studies and site

investigation activities to plan transmission projects.

- IRA Interregional and Offshore Wind Electricity Transmission Planning, Modeling, and Analysis, Sec. 50153 has an available $100M for planning, modeling and analysis of clean energy grid integration, grid weatherization efforts, evaluating increased regional interconnections/interties, and identifying opportunities for use of non-transmission alternatives, energy storage, and grid-enhancing technologies. These funds would be ideal for working with New York and New Jersey to study the benefits that can be achieved through interregional collaboration on potential transmission design.

2. *Comment on ways to minimize adverse impacts to ratepayers including, but not limited to, risk sharing, ownership and/or contracting structures including cost caps, modular designs, cost sharing, etc.*

   Response: PSEG applauds the initiative from the Participating States to seek comment on best incorporating offshore wind renewable energy into the grid while minimizing the potential impact to rate payers.

   As presented in the ISO-NE 2050 Transmission Study, interface transfers will be highly impacted not only by inclusion of offshore wind, but also by a change in load profile which includes a shift from summer peaking to a winter peaking "largely due to growth of heating electrification" [1]

   The total miles of lines overloaded in 2050 is 4,500 or 50% of the total NE line miles.[2] Therefore a coordinated approach should be taken into consideration when determining the optimal Point of Interconnection (POI) to inject offshore wind energy. This should not be left to the developer, but should follow an approach similar to the one adopted by NJ BPU and PJM through the SAA to seek solutions that best address the total system needs. Working together with ISO-NE, the Participating States can model the solutions that will be achieve these goals.

   Furthermore, it is important to clarify the type of reliability profile and the operational flexibility the Participating States are seeking. These will be key factors in determining whether a meshed grid is important or not. We have seen how, little by little, European countries such as Germany and Netherlands have shifted from radial offshore wind transmission to meshed grid. As described in the 2050 Transmission Study, there is a clear need for flexibility to move power from north to south and vice versa in the ISO-NE region. Clarifying up front whether the Participating States desire a meshed grid will guide the developers and other participants in planning for a coordinated offshore system.

[1] 2050 Transmission Study, pages 33 & 36, Preliminary N-1 and N-1-1 Thermal Results.
[2] 2050 Transmission Study, page 18, Preliminary N-1 and N-1-1 Thermal Results.

The Participating States should consider creating a clear delineation between transmission and generation. If the Participating States, in conjunction with ISO-NE, determine a meshed grid is appropriate, it should not be left to the windfarm developers to implement this. Instead, ISO-NE should seek solicitations from experienced transmission owners. Ultimately, this can lead to the elimination of subsidize generation, while attracting reliable offshore transmission system tenants.

Lastly, many Original Equipment Manufacturer (OEMs) offer their standard "modular" design. This is not necessarily what the Participating States should support. Instead, the Participating States should ensure that any modular design is specifically tailored toward meeting New England's unique requirements. PSEG invites the Participating States to consider the unique and modular design we have presented to PJM/BPU as our Coastal Wind Link project. Our offshore platform was designed to accept power from any lease area in the Hudson South or Hudson North Region, promoting a fair and equitable competitive environment for lease holders.

3. *Identify the advantages and disadvantages of utilizing different types of transmission lines, like alternating current (AC) and direct current (DC) options for transmission lines and transmission solutions. Should 1200MW/525kV HVDC lines be a preferred standard in any potential procurement involving offshore transmission lines?*

<u>Response:</u> There is significant amount of literature creating comparisons between AC and DC technologies. Ultimately the drivers for selecting one over the other are:

a. distance;
b. power injection
c. power flow control; and
d. environmental and societal impacts

As presented in the Maine OSW DNV Offshore Wind Transmission Technical Review Report Figure 3-11, AC has physical limitations on transmitting active power over long distances due to cable capacitance. Even with reactive compensation equipment, this system reaches a critical length. AC also requires approximately three times the number of cables/circuits than a 1200MW HVDC system. As shown on Figure 1, the remaining lease areas have a relative long distance (75 - 190 miles) to potential POI. Based on distance and power injection, HVDC technology will be best suited for transmission of offshore wind to the POI.

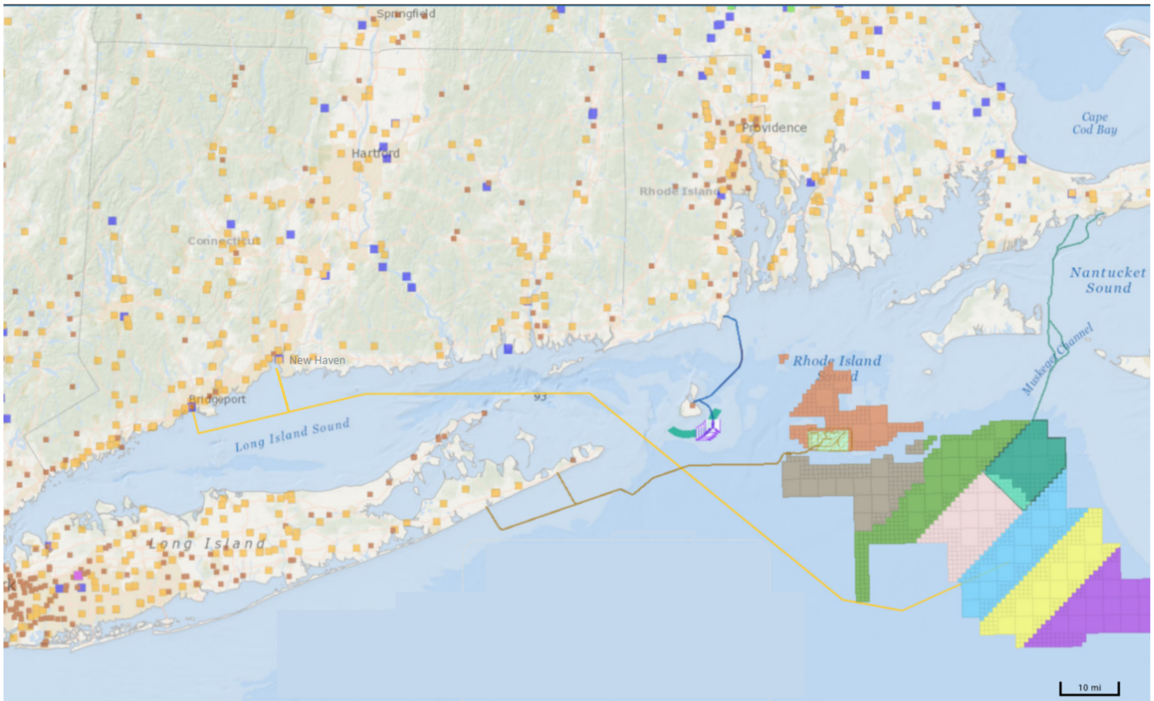

Figure 1: North East Lease Areas

If an offshore meshed grid is required, HVDC offers high controllability in addition to offering windfarm developers ancillary services such as fault-ride-through, reactive power compensation, and voltage control and support to ensure optimal operation of the system. Purely AC offshore grids do not offer this level of power flow control.

Furthermore, in their October 26th order announcing the results of the State Agreement Approach (SAA), the New Jersey Board of Public Utilities concluded that HVDC is preferable to HVAC technology noting the advantages of HVDC over long distances, fewer physical cable are required, the overall industry trend of HVDC technology for larger offshore wind farms, and the fact that other states (e.g. New York) have made a definitive choice in favor of HVDC technology.[3] The lower number of cables needed for HVDC reduces the overall footprint and real-estate needs for the transmission corridors. While HVDC converter stations will be needed, these typically could be placed next to existing switch yards.

4. *Comment on whether certain projects should be prioritized and why. For example, should a HVDC offshore project that eliminates the need for major land- based upgrades be prioritized over another HVDC offshore project that does not eliminate such upgrades;*

<u>Response</u>: This is highly dependent on the approach the Participating States and ISO-NE take in their offshore wind solicitations. In PSEG's view, the prioritization should be as follows:

[3] BPU Docket No. QO20100630, NJ BPU Order published October 26, 2022, p. 43

a. POI Identification: Determine the optimal POI(s) by considering the optimal zonal injection, the thermal constraints and costs to resolve those constraints, and onshore cost of the system from cable landing to the selected POI(s). States should also consider projects that allow for connections into multiple POI(s) adding resiliency and the ability to move power between POI(s) as a benefit.
b. Offshore transmission system that targets multiple offshore wind lease areas and has flexibility to adapt to new wind turbine technologies including array cable voltage increase.

Both prioritizations described above can be achieved simultaneously or in a stepwise approach. Considerations for a and b should also include schedule, as it's critical that network upgrades be completed ahead of offshore transmission, and offshore transmission ahead of generation by at least 6 months to a year.

Proper upfront planning is critical for the implementation of offshore wind projects and grid integrations. A HVDC offshore transmission system that targets multiple offshore wind lease areas, has flexibility to adapt to new technologies including cable voltage increases. Creating a meshed approach connecting to multiple POI's would reduce the need for major land upgrades, add flexibility for growth and allow for power to be moved between the land-based POI's.

Offshore wind generation will need to find a pathway to onshore POI's. A direct connection to a land-based POI by the developer would just service a single project, with impacts multiplying with each new project. Having a meshed offshore HVDC system delivering to multiple POIs reduces the need for major onshore upgrades, and greatly reduces outage risks and single points of failure, while also reducing offshore impacts compared to the single connection approach.

5. *Identify any regional or interregional benefits or challenges presented by the possibility of using HVDC lines to assist in transmission system restoration following a load shedding or other emergency event and particularly from using the black start capabilities of HVDC lines in the event of a blackout*;

Response: HVDC technology is able to support dynamic performance of the grid. An HVDC transmission system can provide grid voltage control and support. The speed response is in the range of few cycles and the resolution is high. The HVDC systems also have Fault-Ride-Through capabilities which allows power transmission to continue even during an onshore fault event. All these increase grid resiliency and higher availability and reliability. Furthermore, because HVDC systems offer high level of control, it's possible to lower LMP's during onshore congestion by routing power through the offshore grid.

Nonetheless, there are many challenges that need to be overcome; some from a technology level and some from a policy level. Regarding technological challenges, IP limits the HVDC vendors' ability to communicate between systems. In order for systems to achieve this, more research and testing is required. Furthermore, while HVDC has black start capabilities, these cannot materialize when used for offshore wind. The main reason is that there is a lock of inertia in the offshore collector system since the rotors of the WTGs are electrically de-coupled from the onshore grid.

States must establish interregional cooperation and agreement including cost allocation for interconnecting between states.

6. *Identify the benefits and/or challenges presented by using land based HVDC lines or other infrastructure to increase the integration of renewable energy (other than offshore wind) in New England to balance injections of offshore wind*;

   Response: ISO-NE and other grid planners are on the right path with front-end transmission planning to determine regional goals, achieve regulatory approval and stakeholder support to identify benefits and challenges within renewable energy integration. MISO's case study of Long Range Transmission Planning (LRTP) "Enabling Low-Cost Clean Energy and Reliable Service Through Better Transmission Benefits Analysis"[4] shows its alignment with the Federal Energy Regulatory Commission's (FERC) proposal in the ongoing Notice of Proposed Rulemaking on Transmission Planning and Cost Allocation[5] to have public utility transmission providers in each region identify transmission needs due to resource mix changes and demand using Long-Term Scenarios. MISO LRTP benefits are assessed in comparison with the 12 categories of benefits proposed by FERC. The list of potential benefits includes (1) avoided or deferred reliability transmission projects and aging infrastructure replacement; (2) either reduced loss of load probability or reduced planning reserve margin; (3) production cost savings; (4) reduced transmission energy losses; (5) reduced congestion due to transmission outages; (6) mitigation of extreme events and system contingencies; (7) mitigation of weather and load uncertainty; (8) capacity cost benefits from reduced peak energy losses; (9) deferred generation capacity investments; (10) access to lower-cost generation; (11) increased competition; and (12) increased market liquidity.

   Land-based HVDC lines could potentially reduce environmental impacts since they typically can be installed in a narrower right-of-way than HVAC. HVDC is more efficient, having lower capacitive losses which in turn lowers energy use, lowering GHG emissions. HVDC also typically can carry a higher MW load reducing the number of cables needed vs. the equivalently-rated HVAC lines.

7. *Comment on the region's ability to use offshore HVDC transmission lines to facilitate interregional transmission in the future;*

   Response: HVDC provides precise power flow control, thus is capable of enabling interregional transmission. However, the biggest obstacle to interregional transmission infrastructure is the current lack of a clear regulatory mechanism to inter-regionally plan and then allocate the costs of these projects across regions. As mentioned in the response

[4] A Case Study of MISO's LTRP, available at: https://acore.org/enabling-low-cost-clean-energy-and-reliable-service-through-better-transmission-benefits-analysis-a-case-study-of-misos-long-range-transmission-planning/.

[5] *Bldg. for the Future Through Elec. Reg'l Transmission Planning & Cost Allocation & Generator Interconnection,* Notice of Proposed Rulemaking, 179 FERC ¶ 61,028 (2022) ("NOPR").

to question 1, there are DOE funds available for study and site investigation activities to plan such projects.

8. *Comment on any just-transition, environmental justice, equity, and workforce development considerations or opportunities presented by the transmission system buildout and how these policy priorities are centered in decisions to develop future infrastructure*;

   Response: Activities that could potentially impact environmental justice communities include but are not limited to commercial fishing engagement, structure placement, port utilization, landfall/onshore and nearshore cable installation/POIs, and air emissions. That said, transmission system build out that enables the installation of offshore wind is an important component of combatting climate change and displacing fossil fuel generation, and thus is an overall contributor to improving air quality and human health in environmental justice communities.

   Furthermore, the Participating States should consider re-purposing Brownfield sites such as former fossil fuel power plans to bring offshore wind power to shore. These sites have already been developed, reducing the impact to the environment and disruption to local communities.

9. *Comment on how to develop transmission solutions that maximize the reliability and economic benefits of regional clean energy resources*.

   Response: Flexibility in the ultimate transmission solution is the critical aspect that must be at the front end of any selected proposal to maximize long-term reliability and ensure project economics are viable. Any offshore wind project and/or transmission solution in the future needs to be designed in a way so that future technological advances can be incorporated, additional megawatts (from initial goals) can be brought onshore, and benefits from newer technologies can be realized without rework. For example some aspects of Coastal Wind Link that the Participating States can consider in development of their transmission solution include:

   - **Future HVDC Interlinks**
     Although currently not commercially available, in the next few years this technology should be available. Provisions for this should be included in any future solicitation ISO-NE is considering. In the design of Coastal Wind Link, although the interlink system proposed was HVAC, the project considered this and also included provisions for accommodating HVDC interlinks when they become commercially available.
   - **Increased Lease Areas Output**
     As wind turbines increase in size so do the voltage for array cables, this means the technology selected in the next couple of years should be flexible enough to incorporate. Coastal Wind Link design utilized 275kV WTG feeder cables that allows for the system to be future-proof, enabling offshore wind generators to choose the most efficient WTG design and ultimate array cable voltage. Furthermore, the design utilized a 400kV HVDC technology to reduce losses over long distances and minimizes cabling, delivering multiple efficiency gains.

- **Inclusion of items to extend project life**
  Spare parts and extra reliability items such as additional switchgear and additional steel thickness – that will extend the life of the assets 25 to 40 years should be considered.
- **Dynamic Grid Support**
  As renewables become an increasingly greater mix of the ISO-NE generation mix, the need to effectively deal with higher renewable penetrations and the intermittent nature of the supply increases. This makes it important that any long term plan include dynamic control capability.

B. **Comments on the Draft Modular Offshore Wind Integration Plan (MOWIP):**

10. *Identify potential Points of Interconnection (POIs) in the ISO-NE control area for renewable energy resources, including offshore wind. What are the benefits and weaknesses associated with each identified POI? To the extent your comments rely on any published ISO-NE study, please cite accordingly;*

Response: The 2021 Load Concentration from the ISO-NE is 34.7% for CT and 41.5% for MA. The expected load growth trend is to continue to increase based on population density projections and increase in the further heating electrification.[6] The ISO-NE 2050 preliminary transmission study indicates that from 2040 to 2050 there is a significant increase in overloads in MA, CT, and NH. The winter evening peak profile indicates significant overloads at the CT imports. According to the ISO-NE 2050 preliminary transmission study, 181 miles of 345kV lines are overloaded, and; 345kV line overloads are generally associated with transfer issues. The report also indicates that points out there is "significant surplus of generation and imports in North, deficit in South."[7] Largest deficit occurs in CT and MA as demonstrated by the Table 1 below.

Table 1: 2050 State Imports Forecast

State	Generation and Imports (MW)	Net Load (MW)	Excess Generation and Imports (MW)
ME	12011	5359	6652
NH	5630	5147	483
VT	1862	2432	-570
North Total	19503	12938	6565
MA	23312	27091	-3779
RI	6781	3877	2904
CT	10618	14027	-3409
South Total	40711	44995	-4284

[6] 2050 Transmission Study, page 36, Preliminary N-1 and N-1-1 Thermal Results.
[7] 2050 Transmission Study, page 47, Preliminary N-1 and N-1-1 Thermal Results.

We believe there are two ways to solve this deficit: either by upgrading the onshore 345kV transmission system to enable the import capacity to increase, or redistributing generation to the load pockets. The latter will offer additional ancillary benefits and grid resilience.

Focusing on Connecticut, the first step is to identify POI's near the Connecticut shoreline that may enable the integration of offshore wind power to where it is most needed. PSEG has identified two locations with sufficient real estate to house HVDC converter stations. These locations include shore locations at Bridgeport and New Haven. PSEG owns and holds property adjacent to Bridgeport Energy, and has an option to purchase a property at New Haven Generating Station.

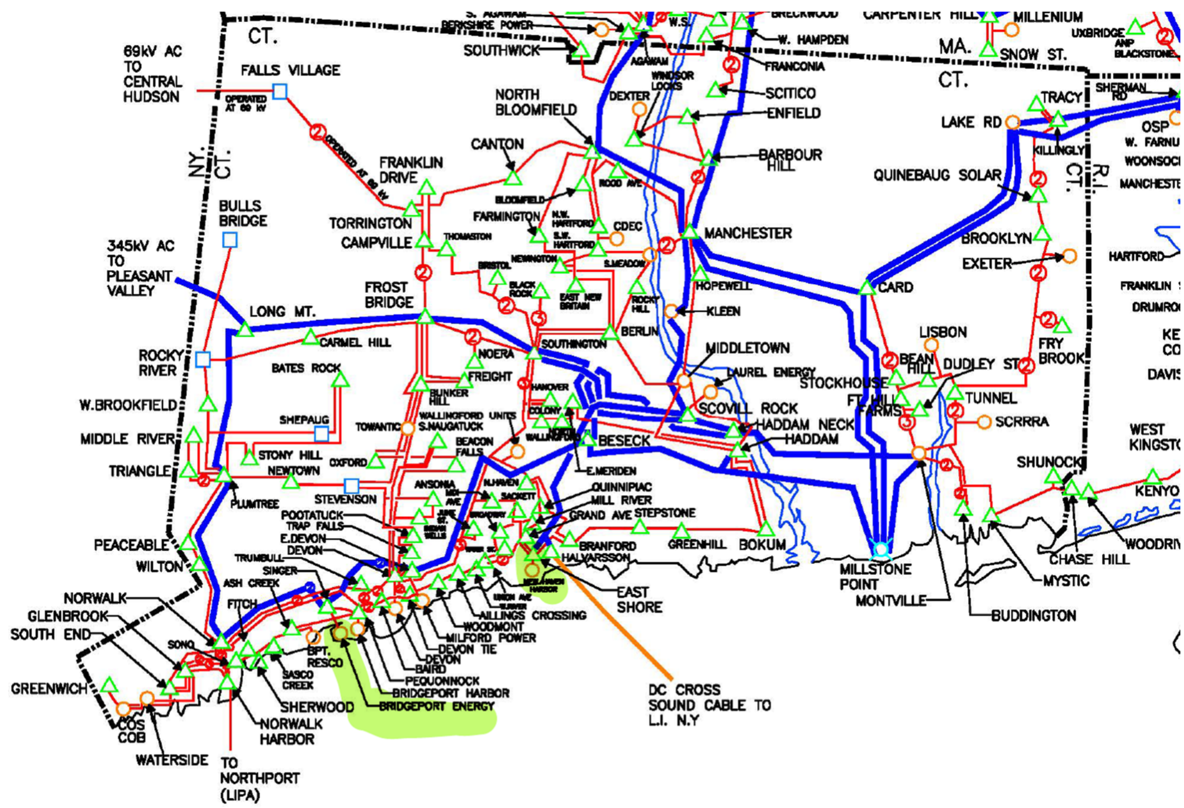

Figure 2: ISO-NE 345kV Backbone

As observed on Figure 2, both New Haven and Bridgeport sites are relatively close to the 345kV grid and are able to inject significant amount of megawatts. Bringing offshore wind energy into these two locations could help CT avoid costly and disruptive upgrades in the 345kV system. Furthermore, HVDC injection at that point would offer ancillary services such as STATCOM mode to support the grids needs with reactive power compensation. It would also enables future offshore grid points to transfer power based on the demand, whether it be from north to south or south to north whenever there is congestion at the onshore grid.

11. *Similarly, comment on whether there are benefits to integrating offshore wind deeper into the region's transmission system rather than simply interconnecting at the nearest landfall (e.g., using rivers to run HVDC lines further into the interior of New England). If there are enough benefits to make this approach feasible, please comment on any obstacles, barriers, or issues that Participating States should be aware of regarding such an approach;*

    Response: The benefit of interconnecting deeper within the transmission system can be identified by performing in depth cost benefit analysis. In ISO-NE, the backbone is 345kV and travels relatively close to the shore. Interconnecting at or near these 345kV backbone will enable the injection of large amounts of power into the grid. Furthermore, to reduce the risk of grid congestion, it would be best that the interconnection happens in the south end of the 345kV backbone as that is where the load concentration exists. PSEG recommends including Bridgeport and New Haven locations in the analysis of optimal POI's.

    If there are deeper inland POIs that provide significant benefit, consider the use of rivers to interconnect to the POI. This can avoid constructing long onshore transmission from landfall to identified POI, which can further disrupt local residents within heavily populated areas and may be prone to objection and encountering conflicts with existing congested utilities. Aquatic transmission obstacles include constructability and environmental obstacles. Shallow waters create difficulties for vessel travel which also makes challenging to lay down cable. Other challenges include migratory fish breeding areas, native plant & wildlife, and aquaculture, which need to be avoided and/or minimized. Impacts to these resources may trigger the need for additional studies, monitoring requirements, and mitigation.

    Additional items to consider of installing within river systems are depth of burial cable due to dredging activities, recreational boating and vessel anchorages. River bottoms must be evaluated for potential contaminants in sediment, fishing communities' impacts, and cultural resources.

    Overall, a strong Alternative Analysis would be needed to assess impacts collectively to determine whether the benefits in terms of thermal constraints and the ability to interconnect to locations on the grid most capable to support the power injection outweigh the challenges and associated costs over an onshore solution.

12. *Identify likely offshore corridor options for transmission lines. Please comment on the potential for such corridor options, include size of the corridor footprint and potential number of cables that can be accommodated, to minimize the number of lines and associated siting and environmental disturbance needed to integrate offshore wind resource. For any offshore corridor identified, please indicate how the corridor avoids or minimizes disturbances to marine resources identified in the applicable plan, including the Connecticut Blue Plan and the Massachusetts Ocean Management Plan;*

    Response: PSEG has the benefit of owning a large parcel of land at the site of our retired Bridgeport Generating Station and an exclusive easement at the New Haven Harbor Generating Station. These would make excellent landfall locations due to being waterfront properties and having close proximity to existing transmission switchyards, which will significantly minimize the potential onshore routes. The offshore route distance to the PSEG-owned landfall would vary from approximately 110 miles to 190 miles, depending on which lease area it is connecting to. These offshore route lengths would result in the project being a HVDC project. One of the benefits of an HVDC project is that it will have fewer export cables than an AC project of the same MW size. Fewer cables results in fewer environmental disturbances, and a narrower cable corridor.

In order to identify a specific cable route/corridor, there are many factors that need to be considered. Every potential route will need to consider all of these factors, and their impact will vary from route to route. These factors include but are not limited to:

1. Basic route determined by:
    - The windfarm lease area location
    - The landfall location

2. Areas to avoid:
    - Unexploded ordinances and munitions
    - Restricted naval areas
    - Anchorage areas
    - Historical dump areas
    - Historical dredge disposal sites
    - Other charted hazard or restricted areas
    - Certain fishing areas, including marine protected areas and bottom trawling areas
    - Certain fish habitats
    - Boulder fields
    - Artificial reefs
    - Other lease areas

3. Obstructions to avoid:
    - Shipwrecks
    - Abandoned piers

4. Existing utility considerations:
    - Attempts are made to avoid existing utilities such as:
        - Communication cables
        - Power cables
        - Pipelines
        - Unmapped decommissioned utilities
    - If an existing utility must be crossed, then it is best for the route to cross it in a perpendicular method
    - If our power cable is run near or parallel to an existing utility, then the distance will be considered to allow repairs by both entities.

5. Seabed considerations:
    - Extreme seabed slopes

- Sandwave areas
- Seabed materials (clay, gravel, sand)
- Paleochannels
- Bathymetry data (depth of water)
- Geotechnical data (ex. Thermal resistivity)

6. Vessel traffic considerations:
   - Vessel Routing Measures
   - USCG Fairways and BOEM Transit Corridors

7. Number of cables:
   - The number of cables being routed is also a considerations during cable routing. Space must be left between cables to allow proper repair access for each cable, as well as to insure the cables do not have a thermal impact on one another.
   - Once the overall cable corridor width is determined based upon the number of cables and associated spacing, this width is factored into the cable routing to make sure there is adequate room.
   - The number of cables is determined by:
     - The size (MW's) of the associated windfarm(s) output
     - Whether the export cables will be AC or DC. Projects with AC cables will require more cables than projects with DC cables for windfarms of the same size.

13. *Identify strategies to optimize for future interconnection between offshore converters, either AC or DC, to permit power flow between converters to facilitate the transmission of power from offshore to multiple POIs as needed. Similarly, comment on the ability of offshore converters from competing manufacturers to communicate with one another in this future case;*

Response: HVDC offers great opportunity for power flow control. Unlike AC, which follows the path of least resistance, HVDC can very accurately direct specific power one way or another. HVDC also offers the ability to support the grid with dynamic reactive power compensation. To quantify the value of these however, it is important to understand how much control the ISO is actually planning to use.

The tools used by today's ISO do not evaluate the value of such controllability or the ancillary services HVDC system provides. To go a step further, it's unknown how ISO-NE would operate an HVDC meshed grid. Therefore, it is critical that a baseline be established as to how the system will be operated in order to identify the type of investment needed in these offshore platforms.

Questions such as the following will dictate the level of investment and the type of proposals HVDC vendors and developers will put forward:

- How much additional power do the Participating States want these HVDC links to transfer? (Type of overload capability will determine size of HVDC modules)

- How much reactive power is expected to be consumed or absorbed by the system? (Usually 50% of active power available. It can impact the cost)
- How will the HVDC link be used in the summer? How will it be used in the winter? (Direction and amount of power flow through interlinks will impact design)
- What type of availability is expected from the system? (Define a target Energy Availability)
- Does the HVDC require Fault-Ride-Through capability? (Determine if Dynamic Breaking Capability is required)

The limiting component in HVDC Grid Connection Systems is the cable. Offshore wind developers are able to use levers such as Dynamic Line Rating to increase available cable power transfer capability. However, this lever is available due to the intermittent nature of offshore wind generation. When interlinking between offshore platforms, the cable ratings must achieve 100% load factor in order to take full advantage of the offshore grid. This unfortunately will impact the rating of the cable. For example, a ±320kV HVDC Grid Connection System with the same cable can have two ratings based on how it is used (radial or meshed). Therefore the cable will ultimately determine the rating of the system and not the HVDC converter.

If higher system availability is required, then using high-capacity AC interlinks might be a better option, as AC interlinks do not depend on the HVDC converter to be energized to be operational. Another consideration is the maintenance needs of the system, and how important it is to the ISO to have the system available during outages. It's also likely that an offshore AC meshed grid be easier to implement among competing manufacturers than a DC meshed grid. Compatibility at the AC end is much easier than compatibility on the DC end. For compatibility in the AC end, it is important to establish a Master Controller. This Master Controller would need to be developed by a third party and would take the block box design from the HVDC manufacturers and allow them to communicate and control the power flow. This is underway already in the North Sea where a Siemens HVDC system will be connected to a Hitachi HVDC system interlinked at the AC end.

On the other hand, interlinking on the DC end is much more complicated. The two leading HVDC manufacturers are taking different approaches to DC interlink. One is opting for HVDC Breakers while the other is opting for a complete different method. Establishing a Master Controller is the least of the issues. On the DC end they face technology compatibility issues, and what is more important a potential single point of failure that can create a possible blackout condition in the grid.

Regardless of the choice, both AC and DC interlinks will require 12 to 18 additional months of studies and test before it can be implemented in a project design. Europe is taking steps to start these studies,8 and in the US this needs to take place immediately as well. In Europe, these studies are underway utilizing Bipole HVDC systems.

14. *Comment on the benefits and/or weaknesses of different ownership structures, such as a consortia of developers with transmission owners or use of U.S. DOE participation as an anchor tenant through its authorizations in the federal Infrastructure and Investment Jobs Act, for new offshore transmission lines;*

    No response at this time.

15. *Comment on cost allocation mechanisms that would prevent cost-shifting between the states based on their policy goals and ensure that local and regional benefits remain quantifiably distinct. How should any future potential procurement identify and distinguish local, regional, and state-specific benefits (e.g., reliability) such that ratepayers only pay for services that they benefit from?*

    No response at this time.

16. *Comment on the benefits and/or weaknesses of using a public-private partnership that might include one or more states or U.S. DOE as part owners with private developers or other sources; and*

    No response at this time.

17. *Comment on the co-benefits of landfalling offshore transmission lines, such as improvements to reliability and/or resilience (i.e., through the use of HVDC converters or otherwise), economic development (e.g., port development, hydrogen production, etc.) and any local system benefits. Identify ways to measure and maximize these co-benefits when evaluating transmission buildout.*

    <u>Response:</u> Targeting landfall locations which minimize onshore impact is essential. For example, the PSEG owned Bridgeport Harbor property could house a converter station and other facilities such as hydrogen production all within a small footprint. Bridgeport Harbor not only houses industrial waterfront development, but available electric substation capacity and natural gas infrastructure which could be used to support hydrogen development.

    The onshore construction impacts would be minimized by concentrating them in the industrial area of the retired coal generating station, along with any new construction.

    The skills of the local craft workforce are second to none, and repurposing existing energy infrastructure could contribute to the creation of skilled jobs in an environmental justice and economically disadvantaged community.

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[8] Wind Europe report "Workstream for the development of multi-vendor HVDC systems and other power electronics interfaced devices"